DEPARTMENT OF THE NAVY
U. S. NAVAL AMMUNITION DEPOT
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9 JUN. 1967

From: Commanding Officer, U. S. Naval Ammunition Depot, Crane, Indiana
To: National Aeronautics and Space Administration, Goddard Space Flight Center, Electrochemical Power Sources Section (716.2), Space Power Technology Branch, Greenbelt, Maryland 20771

Subj: Monthly Progress Report on National Aeronautics and Space Administration Space Cell Test Program; submission of (3 copies)

Encl: (1) Monthly Progress Report as of 28 Feb 1967

1. The progress report for Goddard Space Flight Center purchase order S-23404-G on the space cell test program is submitted as enclosure (1).

C. G. LYNCH
By direction

Copy to:
NASA (Mr. Ernst M. Cohn, RNW), Washington, D. C. 20546
NASA (Mr. Emil Hymowitz, 672), Greenbelt, Maryland 20771
NASA, Scientific and Technical Information Facility (NASA REP RQT-20238), Bethesda, Maryland 20014

1. Burgess-Borden Cells:

a. These 10 ampere-hour silver-zinc cells are being tested for separator quality and performance at room temperature under the following conditions:

(1) Pack 8: Pudo Separator Material, Cells number 1-10.

(a) Pack failed on cycle 269.

(2) Pack 9: Pudo Separator Material, Cells number 11-15 and C-3 Separator Material, Cells number 11-15.

(a) These cells are discharged individually at the c/5 rate to a terminal voltage of 1.3 volts per cell. Following a stand of 6 to 8 hours in the discharged state, the cells are then charged at the c/20 rate to give each individual cell an input of 120 percent of its previous discharge. Upon completion of a 30-day stand in the charged condition, this cycle is repeated.

1. Pudo Cells Still Cycling: 1

2. C-3 Cells Still Cycling: 3

3. Cycles Completed: 18

(3) Pack 16: C-3 Separator Material, Cells number 36-40 and 9107/12, Cells number 1-5.

(a) The cells are discharged individually at the c/5 rate to a terminal voltage of 1.3 volts per cell. Following a stand of 6 to 8 hours in the discharged state, the cells are then charged at the c/20 rate to give each individual cell an input of 120 percent of its previous discharge. Upon completion of a 30-day stand in the charged condition, this cycle is repeated. The electrolyte in these cells is a 30 percent KOH colution.

1. C-3 Cells Cycling: 5

2. 9107/12 Cells Still Cycling: 2

3. Cycles Completed: 11

(4) Pack 17: C-3 Separator Material, Cells number 41-45.

(a) The cells are discharged individually at the c/5 rate to a terminal voltage of 1.3 volts per cells. Following a stand of 6 to 8 hours in the discharged state, the cells are than charged at the c/20 rate to give each individual cell an input of 120 percent of its previous discharge. Upon completion of a 30-day stand in the charged condition, this cycle is repeated. The electrolyte in these cells is a 40 percent KOH solution.

1. Cells Cycling: 4

2. Cycles Completed: 11

3. Cell 1 failed on Cycle 7.

2. Yardney-G.E. Auxiliary Electrodes, 12 Ampere-Hour, Pack of 8 cells:

a. The plates for these cells were made by the Yardney Electric Corporation and the auxiliary electrodes were made by the General Electric Company. These cells have completed 100 cycles at each of three temperatures; 0° C, 25° C and 40° C; consisting of discharges for 1 hour at 5.2 amperes followed by constant potential charges to 1.51 volts per cell average with current limited to 0.5 ampere. The same cycling program is continuing at 25° C.

(1) Cells Cycling: 6

(2) Cycles Completed: 694

3. Sonotone, 3.5 Ampere-Hour, Nickel-Cadmium Cells:

a. Overcharge Test, one pack of 10 cells. These cells are being charged at 35 milliamperes for 1 year, with cell voltages read once a week.

(1) Cells on Test: 10

(2) Time on Charge: 11 months

b. Open Circuit Stand Test, one pack of 10 cells. These cells were charged at 350 milliamperes for 16 hours. They are now on open circuit stand for 1 year with cell voltages read once a week.

(1) Cells on Test: 10

(2) Time on Open Circuit Stand: 11 months

(3) One cell failed which was replaced by one of the spares.

4. IMP 19:

a. In this test we are simulating the operating of the IMP satellite (Explorer XXVIII) battery. The simulating test is running approximately 60 days behind the launch of the satellite. The battery is in a vacuum chamber at approximately 25 microns. The charging current varies sinusoidally to simulate the satellite's rotation of 0.75 c.p.s. The test is conducted with test parameters received periodically from the project office. The parameters include charge and discharge time, charge rate, and temperature. Instrumentation provides a low (discharge) voltage cutoff of 12 volts which simulates lockout on the satellite. Charge

control is provided by means of a two step regulator which provides better cell balance by lowering the voltage limit when the battery is fully charged and is in the float charge mode.

(1) Cycles Completed: 555 days as of 28 February 1967

5. AIMP 06:

a. These 11.0 ampere-hour, silver-cadmium cells have completed their preliminary conditioning tests. The first set of temperature date has been received from Goddard Space Flight Center and cycling has been started.

(1) Days of Cycling: 183

6. Yardney 10HR16S Synchronous Orbit Test:

a. These ten 16 ampere-hour, silver-zinc cells are simulating the battery of a synchronous orbit satellite. The cells are in series, and the charge and discharge periods are of variable duration. A two-step voltage limit regulator is employed during cycling. The upper voltage limit is 1.98 volts/cell and the lower voltage limit is 1.86 volts/cell. The charge current limit is 500 milliamperes.

(1) Cells on Test: 10

(2) Days on Cycling: 127

7. Yardney K969, Silver-Zinc, 12 ampere-hour (Packs 11 and 12):

a. Pack 11 consists of six cells having zinc plates containing 5 percent teflon with separators consisting of 5 turns of C-19 material. Pack 12 consists of six cells, three of which are identical to the cells in pack 11 and three with zinc plates containing 0.5 percent CMC material with separators consisting of 5 turns of 2.2XH RAI material.

(1) Pack 11:

(a) Cells Cycling: 6

(b) Cycles Completed: 40

(2) Pack 12:

(a) Cells with teflon cycling: 2

(b) Cells with CMC material in negative plates cycling: 3

(c) Cycles completed: 40

8. Plitt Seal Overcharge Test with Gulton 3.5 Ampere-Hour Nickel-Cadmium Cells:

a. These cells are charging continuously at the c/10 rate (350 milliamperes).

(1) Cells Cycling: 5

(2) Days completed: 86

9. Burgess-Borden 10 Ampere-Hour Silver Zinc Cells, Separator Test:

a. Pack 21, Separator Materials: 9107/14, 5 cells; 9071/15, 5 cells.

(1) These cells are discharged at 2 amperes. The discharge is terminated on a per cell basis. When a cell reaches 1.3 volts that cell is taken off of discharge. The charging current is 0.5 ampere. These cells are charged until the average cell voltage reaches 1.97 volts. Then the charging current is reduced so that the average cell voltage is held at 1.97 volts long enough to make the total charging time 30 hours.

(a) 9107/14 cells cycling: 5

(b) 9017/15 cells cycling: 5

(c) Cycles completes: 37

b. Pack 22, Separator Materials: 9107/14, 5 cells; 9017/15, 5 cells.

(1) These cells are discharged at 2 amperes. The discharge is terminated on a per cell basis. When a cell reaches 1.3 volts that cell is taken off of discharge. The charging current is 0.5 ampere. The cells are charged on an individual basis until each cell receives a 105 percent recharge.

(a) 9107/14 cells cycling: 5

(b) 9071/15 cells cycling: 3

(c) Cycles completed: 37

c. Pack 23, Separator Materials: 9107/14, 4 cells; 9017/15, 2 cells.

(1) These cells are discharged at 2 amperes. The discharge is terminated on a per cell basis. When a cell reached 1.3 volts that cell is taken off of discharge. The charging current is 0.5 ampere. The cells are charged individually until each cell receives a 120 percent recharge. Then the cells are allowed to stand on open circuit for 30 days.

(a) 9107/14 cells cycling: 4

(b) 9017/15 cells cycling: 2

(c) Cycles Completed: 2

10. Cells to be tested during the next few months:

a. Silver-Zinc Cells:

(1) Type 1. Negatives contain 5 percent teflon as a binder, and a surfactant, emulphogene BC 840. The separator consists of 5 turns of cellophane C19.

b. Several types of Yardney AgCd cells from Contract NAS 5-9106 with pellon/cellophane separation system and teflonated (1%) negatives.

c. Additional silver-cadmium cells with electrodes from G.E. and Gulton.

d. Sealed silver-zinc cells from Delco and Yardney.

e. One hundred additional cells of the Burgess-Borden type. These cells will be tested similarly to the tests described under paragraph 1, above.

f. Cells from Leesona Moos, Contract NAS5-9591, Improvements of the Zinc Electrode.

11. Reporting on these programs will be done by either this activity or Goddard Space Flight Center.